IN THE UNITED STATES PATENT & TRADEMARK OFFICE

APPLICANT:	Stephen L. Ward *et al.*	§	
		§	**GROUP ART UNIT:** Unassigned
SERIAL NO.:	Unassigned	§	
		§	
FILED:	Herewith	§	
		§	
FOR: ALTERNATE PATH GRAVEL PACKING WITH ENCLOSED SHUNT TUBES		§	**EXAMINER:** Unassigned

CERTIFICATE OF MAIL BY EXPRESS MAIL

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September 23, 2003 — Date of Deposit

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MAIL STOP PATENT APPLICATION
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

By: Yvonne R. Simera

September 23, 2003 — Date of Signature

MEMORANDUM OF ART

MAIL STOP PATENT APPLICATION
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Date: September 23, 2003
Docket No.: 000850-10

Sir:

Applicant calls to the attention of the Office the following art which has been cited in the above entitled patent application, for which copies are attached.

In producing hydrocarbons or the like from loosely or unconsolidated and/or fractured subterranean formations, it is not uncommon to produce large volumes of particulate matter (e.g. sand) in conjunction with the formation fluids. As is known in the art, these particles routinely cause a variety of problems that result in added expense and increased downtime. Accordingly, it is extremely important to control the production of these particulates in most operations.

Probably the most common technique for controlling the production of particulates (e.g. sand) from a well is one that is known as "gravel packing". In a typical gravel pack completion, a well screen is lowered into the wellbore and positioned across the interval of the well that is to be completed. Particulate material, collectively referred to as gravel, is then pumped as a slurry down the tubing on which the screen is suspended. The slurry exits the tubing above the screen through a "crossover" tool or the like and flows downward in the annulus formed between the screen and the well casing or open hole, as the case may be.

The liquid in the slurry flows into the formation and/or the openings in the screen that are sized to prevent the gravel from flowing through them. This results in the gravel being bridged on or "screened out" on the screen and in the annulus around the screen where it collects to form the gravel pack. The gravel is sized so that it forms a permeable mass which blocks the flow of any particulates produced with the formation fluids.

One of the main problems with gravel packing, especially where long horizontal or inclined intervals are to be completed, is obtaining equal distribution of the gravel along the entire completion interval, i.e. completely packing the annulus between the screen and the casing in cased hole completions or between the screen and the wellbore in open hole completions. Poor distribution of the gravel (i.e. incomplete packing of the interval resulting in voids/unpacked areas in the gravel pack) is often caused by the dehydration of the gravel slurry into more permeable portions of the

formation interval that, in turn, causes the formation of gravel "bridges" in the annulus before all of the gravel has been placed. These bridges block further flow of the slurry through the annulus causing insufficient placement of the gravel. Subsequently, the portion of the screen that is not covered or packed with gravel is thereby left exposed to erosion by the solids in the produced fluids or gas and/or that portion of the screen is then easily blocked or "plugged" by formation particulates (i.e. sand).

U.S. Pat. No. 4,945,991, Jones, L. G., "Method for Gravel Packing Wells" discloses a screen with rectangular perforated shunt tubes attached to the outside of a screen longitudinally over the entire length of the screen. In this method, the perforated shunts (i.e. flow conduits) extend along the length of the screen and are in fluid communication with the gravel slurry as it enters the annulus in the wellbore adjacent the screen.

If a sand bridge forms in the annulus formed by the screen and the wellbore prior to placing all of the gravel, the gravel slurry will flow through the conduits past the sand bridge(s) and out into the annulus through the perforations spaced along the conduits to complete the filling of the annulus above and/or below the bridge(s). U.S. Pat. No. 5,113,935 is a further modification of this type of well screen. In some instances, valve- like devices are provided for the perforations in these conduits so that there is no flow of slurry through the conduits until a bridge is actually formed in the annulus; see also U.S. Pat. No. 5,082,052.

In many prior art, alternate path well screens, the individual perforated conduits or shunts are shown as being preferably carried externally on the outside surface of the screen; see U. S. Pat. Nos. 4,945,991; 5,082,052; 5,113,935; 5,417,284; and 5,419,394. This positioning of the shunt tubes has worked in a large number of applications, however, these externally-mounted perforated shunts are not only exposed to possible damage during installation but, more importantly, effectively increase

the overall diameter of the screen. The latter is extremely important when the screen is to be run in a small diameter wellbore where even fractions of an inch in the effective diameter of the screen may make the screen unusable or at least difficult to install in the well. Also, it is extremely difficult and time consuming to connect respective shunt tubes attached to the outside of the screen to shunt tubes attached to the outside of the following screen in the course of assembling the screen and lowering it into the wellbore.

In order to keep the effective diameter of a screen as small as possible, external perforated shunt tubes are typically formed from "flat" rectangular tubing even though it is well recognized that it is easier and substantially less expensive to manufacture a round tube and that a round tube has a substantially greater and more uniform burst strength than does a comparable rectangular tube.

An additional disadvantage to mounting the shunt tubes externally, whether they are round or rectangular, is that the shunt tubes are thereby exposed to damage during assembly and installation of the screen. If the shunt tube is crimped during installation or bursts under pressure during operation, it becomes ineffective in delivering the gravel to all levels of the completion interval and may result in the incomplete packing of the interval. One proposal for protecting these shunt tubes is to place them inside the outer surface of the screen; see U.S. Pat. Nos. 5,476,143 and 5,515,915. However, because these prior art, alternate path well screens incorporate the perforated shunts and require that holes be drilled in the wire wound portions of the screen and/or the shunt tubes, some additional form of seal between the drilled hole in the wire and shunt tube is needed to prevent slurry flow and possible erosion in the internal surface of the screen annulus formed with the base pipe. This substantially increases the cost of the screen without substantially decreasing the over all diameter of the screen. In addition, the connections between the joints of screen in these prior art well screens, require either a union type connection, which is understood by those skilled in the art, that is

incapable of withstanding torque being applied, a timed connection to align all of the shunt tubes from screen joint to screen joint, a jumper shunt tube between screen joints or a cylindrical cover plate over the connection between screen joints that is either welded to the base pipe or held in place by metal bands. All of these alternatives are expensive, time consuming and/or very difficult to handle on the rig floor while making up and installing the well screens.

Other downhole well tools have been proposed for fracturing a formation (U.S. Pat. No. 5,161,618) or treating a formation (U.S. Pat. No. 5,161,613) whereby individual conduits or shunt tubes are positioned internally within a housing or the like to deliver a particulate treating or fracturing fluid to selective levels within the wellbore. However, the outlets through the housing of these tools remain open after the particular operation is completed which would be detrimental in gravel packing completions since the produced fluids could then carry particulates back into the housing through these openings after the gravel pack has been completed and the well has been placed on production.

U.S. Pat. No. 5.333,688 discloses a gravel pack screen having shunt tubes positioned within the base pipe of the screen where they do not increase the overall diameter of the screen. Gravel slurry carried by these shunt tubes is delivered to different levels in the well annulus around the screen through the spaced outlets through the housing. However, by placing the shunt tubes within the base pipe (i.e. ultimately part of the production flowpath), an intricate and sophisticated valve is required to each of the outlets after the gravel packing operation is completed, thereby adding substantially to the costs of the screen and of installation. As well, with the shunt tubes in the production flowpath any remedial or production data gathering work will be inhibited by the tubes and will cause such work to be expensive or incapable of being performed.

In addition, unlike the present invention, there are no exit nozzles in U.S. Patent No. 5,476,143 and 5,515,915 but instead there are drilled holes 7. In addition, the prior art does not secure any path for the flow of fluid from exterior to the screens through hole 7 into slurry supply tubes 6. Further, it does not appear that slurry supply tubes 6 are secured to inside of the screen 4 making connections with holes 7 more difficult.

Please send all correspondence regarding the above-referenced application to the undersigned at the address appearing below.

While we believe no fees are due in association with this Memorandum of Art filing, any fees should be charged to Deposit Account No. 15-0697 of David Ostfeld, P.C.

Respectfully,

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